

Application Serial No.: 10/623,243
Attorney Docket No.: 0140111

REMARKS

Prior to the present amendment, claims 1, 3-7, 9-16, and 18-20 were pending in the present application. By the present amendment and response, claims 1, 9, and 16 have been amended. Thus, claims 1, 3-7, 9-16, and 18-20 remain pending in the present application. Reconsideration and allowance of pending claims 1, 3-7, 9-16, and 18-20 in view of the above amendments and the following remarks are respectfully requested.

A. Rejections of Claims 1, 3-7, 9-16, and 18-20 under 35 USC §103(a)

The Examiner has rejected claims 1, 3-7, 9-16, and 18-20 under 35 USC §103(a) as being unpatentable over U.S. Patent Number 5,969,461 to Anderson et al. (hereinafter, "Anderson") in view of U.S. Patent Number 5,720,100 to Skipor et al. (hereinafter, "Skipor"). For the reasons discussed below, Applicants respectfully submit that the present invention, as defined by amended independent claims 1, 9, and 16, is patentably distinguishable over Anderson and Skipor, either singly or in combination.

As disclosed in the present application, conventional multi-chip module or multi-component module (MCM) fabrication processes may reduce the reliability of particular surface mount components included in an MCM and thus reduce the reliability of the overmolded MCM itself. The present invention as defined by amended independent claims 1, 9 and 16 overcomes this reduction in reliability in overmolded MCMs brought forth by conventional MCM fabrication processes.

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The present invention, as defined by amended independent claims 1, 9 and 16, includes a surface mount component (also referred to as "SMC"), having first and second terminals, where the SMC and its terminals are situated over a laminate circuit board (e.g., laminate circuit board 104 in Figure 1 or laminate circuit board 304 in Figure 3). First and second pads are also situated on the laminate circuit board and are coupled to the first and second terminals, respectively. As part of the solution to the shortcomings of the conventional technology, solder mask trench 124 (seen in Figure 1) is formed under a SMC, such as SMC 102 or SMC 302. More importantly, solder mask trench 124 is formed where, in the absence of the present invention, no solder mask opening or trench would be formed. In other words, except for and in the absence of the solder mask trench, the top surface of the laminate circuit board would be uniformly covered with solder mask.

Referring to Figure 1, by forming solder mask trench 124 (in an otherwise uniform blanket of solder mask) underneath the SMC and within solder mask 112, moldable gap 125, with an increased height 128, is advantageously formed and is substantially larger than a conventional moldable gap. By contrast, in a conventional structure, solder mask 112 would fill the region between pads 106 and 108 underneath the SMC. As a result, a conventional moldable gap that would be formed between solder mask 112 and the bottom surface of the SMC would have a reduced height 130, as shown in Figure 1 of the present application.

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Thus, by etching solder mask trench 124 within a uniform blanket of solder mask 112, embodiments according to the present invention advantageously achieve a significantly larger moldable gap, having height 128, that improves molding compound flow underneath the SMC and, consequently, minimizes void formation underneath the SMC. As a result, embodiments according to the present invention advantageously minimize the risk of shorting between the terminals of the SMC during, for example, reflow assembly. See, for example, the present application page 9, lines 19-21. Indeed, since the invention does not require complex changes to the existing technology, the disadvantages of the existing technology in having voids in molding compounds under an SMC are overcome without significantly increasing manufacturing costs. Thus, among other advantages, the reliability of the SMC and the overmolded MCM itself can be significantly increased in an economic manner.

In contrast, the disclosure in Anderson is directed to providing a package that encapsulates a "surface acoustic wave (SAW) device" such that the active area of the SAW device is isolated within a periphery of the device to prevent contamination. See, for example, column 2, lines 12-13 and 23-24. As acknowledged by the Examiner, Anderson does not disclose filling a solder mask trench with molding compound. Moreover, Applicants respectfully submit that the disclosure in Anderson, as seen in Figures 1-3, actually teaches away from the present invention because Anderson stops the flow of any molding compound by disposing dam 26 on top 30 of substrate 16 between

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substrate 16 and acoustic wave device 10. See, for example, Anderson, column 3, lines 29-31 and 48-56.

For example, Anderson teaches the use of a dam that is “a photolithographically-defined standard solder mask material” which “prevents intrusion of foreign materials during overmolding and at any other time.” See Anderson, column 3, lines 39-40 and lines 54-56. Thus, Anderson teaches away from forming a solder mask trench underneath acoustic wave device 10 to facilitate the flow of molding compound because the disclosure in Anderson prevents the flow of molding compound (underfill material 28) by using dam 26 (albeit that dam 26 is comprised of solder mask) to provide a sealed cavity 34 (i.e. a cavity void of molding compound). See, for example, Figure 2 of Anderson and column 5, lines 10-15.

In order to further clarify and distinguish the novel aspects of the present invention, however, independent claims 1, 9, and 16 have been amended and now recite “a solder mask trench situated underneath said surface mount component, wherein said solder mask trench is situated over a top surface of said laminate circuit board, wherein a solder mask uniformly covers said top surface of said laminate circuit board, and wherein said solder mask does not cover said solder mask trench.” Accordingly, the present invention, as defined by amended independent claims 1, 9, and 16, is patentably distinguishable over Anderson. For the reasons that follow, the invention is also patentably distinguishable over Skipor or any combination of Skipor and Anderson

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because neither reference contains any motivation or suggestion to etch a solder mask trench underneath a SMC so as to facilitate the flow of a molding compound.

Skipor discloses an “assembly in which an integrated circuit die is spaced apart from a printed circuit board *by a gap* and is attached by solder bump interconnections that extend across the gap and connect bond pads on the die to bond pads on the board.”

Skipor, column 1, lines 59-63 (emphasis added). More specifically, Figure 2 reveals that gap 30 is defined by die bond pads 28, solder bump interconnections 32, and board bond pads 22. The Examiner, however, states that Skipor “discloses an apparatus wherein the solder mask trench is filled with molding compound.” See the present non-final office action, page 3, lines 5-6. Applicant respectfully disagrees with the Examiner because Skipor does not make any reference to, nor even mentions, the words “solder mask” anywhere in its disclosure. Skipor merely discloses a structure spaced apart by a gap that occurs as a result of the particular assembly involved and not by modifying the solder mask as required by the present invention.

Applicants respectfully submit that one of ordinary skill in the art cannot achieve the present invention as defined by amended independent claims 1, 9, and 16 by combining Anderson and Skipor. Anderson teaches away from the use of a solder mask trench situated underneath a SMC to facilitate the flow of molding compound by disclosing a method that uses solder mask as a dam to prevent the flow of molding compound, while Skipor does not even suggest utilization of a solder mask or a solder mask trench, and does not even mention the phrase “solder mask” anywhere in its

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disclosure. Therefore, there is no motivation or suggestion to combine the cited references to achieve the present invention.

For the foregoing reasons, Applicants respectfully submit that the present invention as defined by amended independent claims 1, 9, and 16 is not taught, disclosed, or suggested by the art of record. As such, the claims depending from amended independent claims 1, 9, and 16 are, *a fortiori*, also patentable for at least the reasons presented above and also for additional limitations contained in each dependent claim.

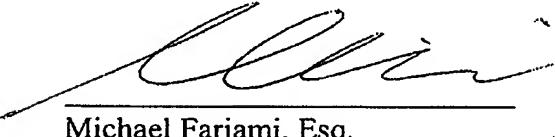
B. Conclusion

Based on the foregoing reasons, the present invention, as defined by amended independent claims 1, 9, and 16, and the claims depending therefrom, is patentably distinguishable over the cited art. Thus, outstanding claims 1, 3-7, 9-16, and 18-20 are patentably distinguishable over the cited art. As such, and for all the foregoing reasons, an early Notice of Allowance directed to all claims 1, 3-7, 9-16 and 18-20 remaining in the present application is respectfully requested.

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Respectfully Submitted,
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